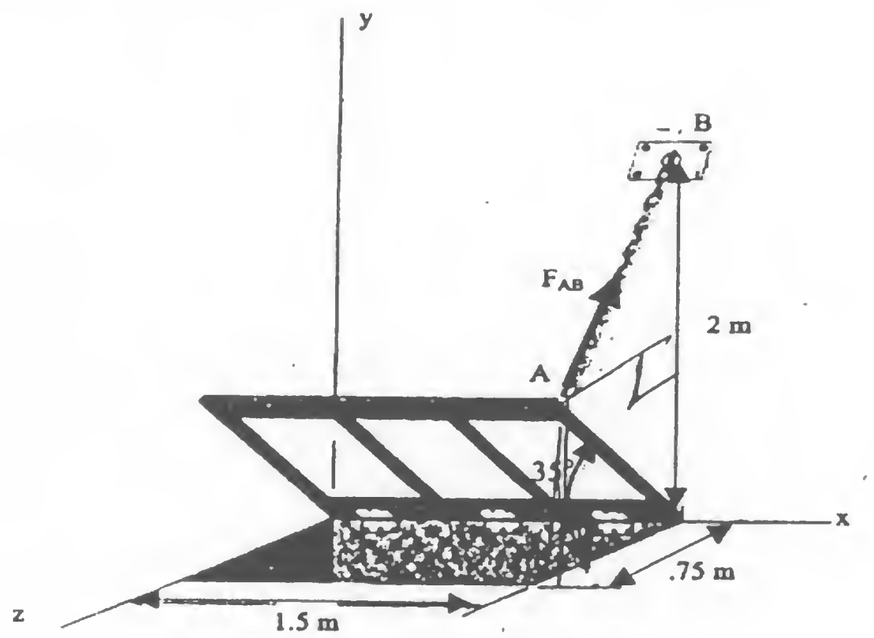
1) Force F_{AB}, acting along the chain AB, has a magnitude of 100.0 N. You may recall that any force can be represented by perpendicular and parallel components.
   a) Express $\mathbf{F_{AB}}$ as a Cartesian vector.
   b) For a perpendicular component $\mathbf{F_\perp} = (-32.34\mathbf{i} + 17.67\mathbf{j} + 6.671\mathbf{k})$ N, calculate:
      i) the magnitude of the parallel component, $F_{//}$
      ii) the vector representation of the parallel component, $\mathbf{F_{//}}$
   c) What is the angle between the perpendicular component and force $\mathbf{F_{AB}}$.



a) forces?

$\cos\theta = \frac{\text{adj}}{\text{hyp}}$ — $\tan 35 = \frac{\text{opp}}{\text{adj}}$

$\tan 35\,(0.75\text{m}) = 0.525\text{m}$

b) i) $\vec{A} = \vec{A}_{//} + \vec{A}_\perp$

$\vec{A}_{//} = \vec{A} - \vec{A}_\perp$

$B = (0m\hat{i} + 1.5m\hat{j} + 2m\hat{k})$

$A = (0.75m\hat{i} + 1.5m\hat{j} + 0.525m\hat{k})$

$\overline{AB} = (-0.75m\hat{i} + 0m\hat{j} + 1.475m\hat{k})$

$(453N + 32.34N)\hat{i}$

$(0N - 17.67N)\hat{j}$

$89.1N - (6.671N)\hat{k}$

3

method?

$\hat{u}_{AB} = \frac{(-0.75m\hat{i} + 0m\hat{j} + 1.475m\hat{k})}{1.655m}$

$= -0.453\hat{i} + 0\hat{j} + 0.891\hat{k}$

$(-12.96N\hat{i} - 17.67N\hat{j} + 82.4N\hat{k})$

$\vec{F}_{AB} = F\,\hat{u}_{AB}$

$= (100N)(-0.453\hat{i} + 0\hat{j} + 0.891\hat{k})$

$\sqrt{(-12.96N\hat{i})^2 + (-17.67N\hat{j})^2 + (82.4N\hat{k})^2}$

$85.3\,N$ 3

2

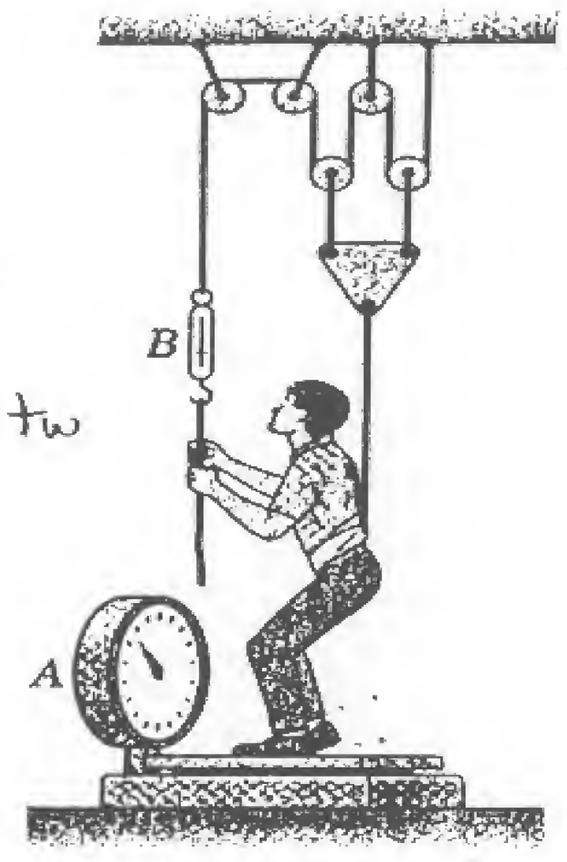
$\vec{F}_{AB} = -45.3N\hat{i} + 0N\hat{j} + 89.1N\hat{k}$

$(-12.96N\hat{i} - 17.67N\hat{j} + 82.4N\hat{k})$

c) $\theta = \arccos\left(\frac{\vec{F}_\perp \cdot \vec{F}_{AB}}{F_\perp F_{AB}}\right) = \frac{(-32.34\hat{i} + 17.67\hat{j} + 6.671\hat{k})N \cdot (-45.3N\hat{i} + 0N\hat{j} + 89.1N\hat{k})}{(37.45N)(100N)}$

$= \frac{1465N^2 + 594.39N^2}{3745.0N^2} = 56.64^\circ$

2) A former student of mechanics wishes to weigh himself but has access only to a scale (A) with a capacity of 100 lb and a small spring scale (B) with a capacity of 20 lb. With the pulley system shown below he discovers that when he exerts a pull on the rope so that B registers 19 lb., the scale A reads 67 lb.
   a) What is his correct weight? Be sure to present clear Free Body Diagrams to support your answer.
   b) Calculate the stretch in the spring scale at B for a spring constant k = 10 lb/in.



FBD

a)

T = 19lb

67

W

4T

W

67lb + W = TW

4T = W

4(19) = 76lb

67lb + 76lb = TW = 143 lb

b)

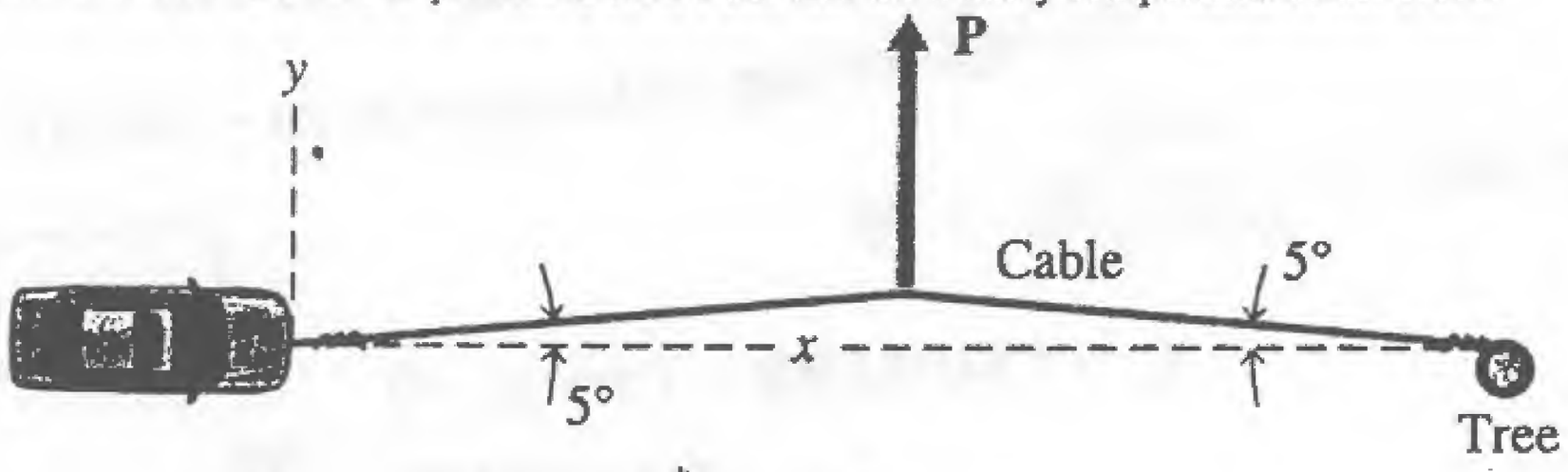
F = kS ✓

143 lb = 10 lb/in (S)

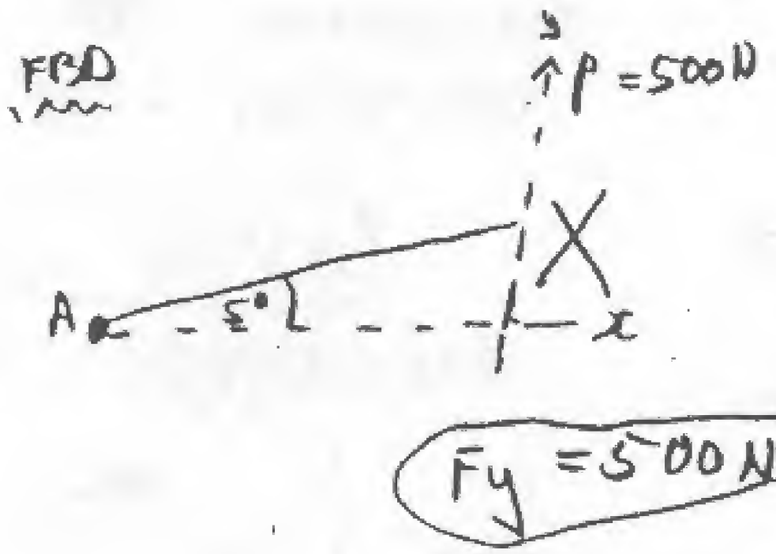
14.3 in = S

(2)

3) An automobile stuck in a muddy field is being moved by using a cable fastened to a tree as shown in the figure below. When the cable is in the position shown and force P = 500 N, determine the x and y components of the cable force being applied to the automobile. Be sure to provide a clear FBD and the x and y components of the force.



FBD

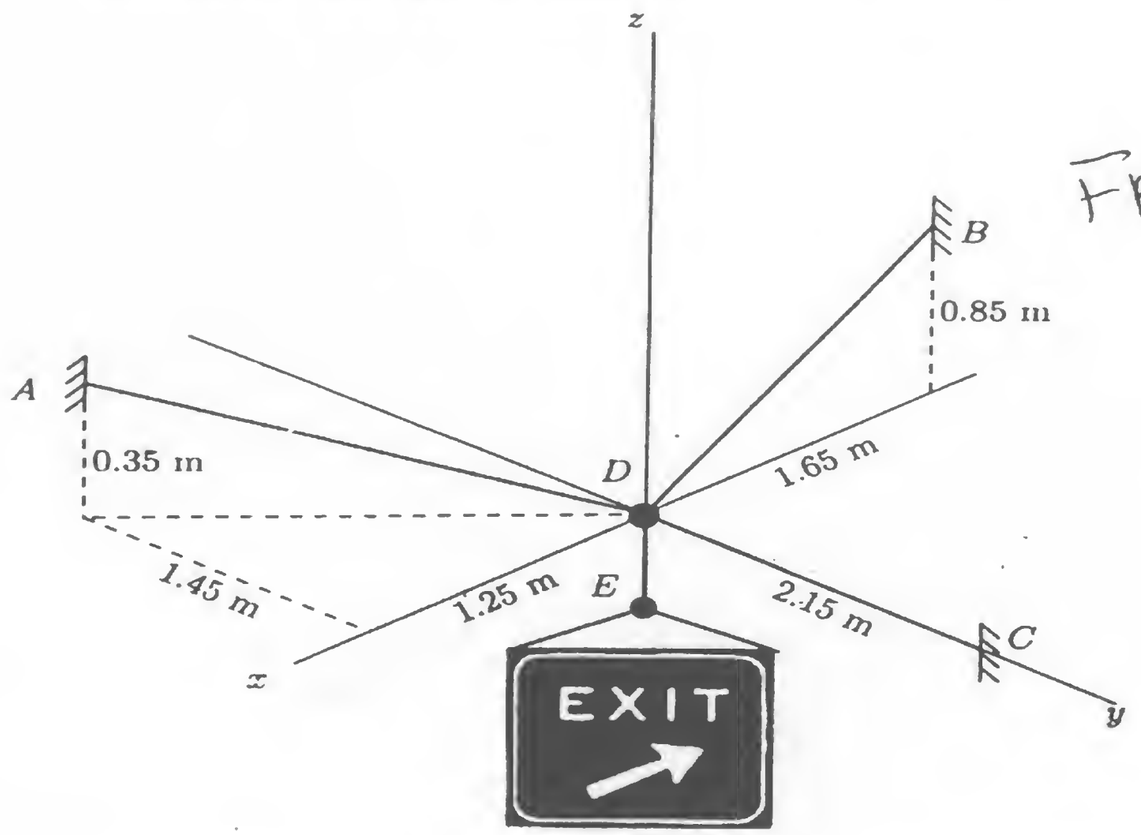


$F_y = 500\ N$

$\tan\theta = \frac{opp}{adj}$

$adj = \frac{opp}{\tan\theta} = \frac{500N}{\tan 5} = 15.0\ N$

4) The 12.5-kg road sign is supported by cables DA, DB, DC, and DE. Determine the force acting in each cable for equilibrium.



FBD?

1.856

1.995

$W = F = mg = 12.5kg\ (9.81\ m/s^2) = 122.6\ N$

Show work/method!

$\vec{DC} = (\quad N\hat{i} + \quad N\hat{j} + \quad N\hat{k})$

$\vec{DE} = (0N\hat{i} + 0N\hat{j} - 122.6N\hat{k})$

$\vec{DB} = (\quad N\hat{i} + 0N\hat{j} + \quad N\hat{k})$

$\vec{DA} = (\quad N\hat{i} + \quad N\hat{j} + \quad N\hat{k})$

$\Sigma \vec{F} = 0$

$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma F_z = 0$

how?

$\Sigma F_x = +DB\ (0.889) + \ldots$

$DA\ (0.642)$

$\Sigma F_y = -DA(0.745) + DC$

$\Sigma F_z = -122.6N + DB(0.458) + DA(0.178)$

$DA = 1.3847(173.7N)$

$DA = 240.5N$

$DE = 122.6\ N$

$DC - DA(0.745)$

$DC = 240.5N(0.745)$

$DA\ (0.642) - DB\ (0.689) = 0$

$DC = 179.2N$

$DA = \frac{DB\ (0.689)}{(0.642} = 1.3847\ DB$

$\Sigma F_z = 0 = -122.6N + DB(0.458) + DB(1.3847)(0.179)$

$122.6N = DB\ (0.458) + DB\ (0.248)$

$122.6N = DB\ (0.706)$

$173.7N = DB$